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HENRY AUGUSTUS ROWLAND.

IN the death of Professor Rowland, at the age of fifty-three, in the fulness of his activity and powers, the world has lost one of its foremost men of genius; America, its greatest scientist; Johns Hopkins University, the teacher and investigator who has brought it most renown.

Henry Augustus Rowland was born at Honesdale, Pennsylvania, Nov. 27, 1848; he entered the Rensselaer Polytechnic Institute, Troy, and received the degree of C.E. in 1870. After a brief experience in practical engineering on a railroad he accepted the position of teacher of science in Wooster College, where he taught physics, zoology and geology for the year 1871–2. He was then called to the Rensselaer Institute as instructor, and was soon promoted to assistant professor. He remained at Troy until he accepted a position at Johns Hopkins University in 1875. The attention of President Gilman of Johns Hopkins University was directed to Rowland by Professor Michie of West Point; and the first meeting of the two took place at the Academy on the Hudson. Before assuming the duties of his new office, at the suggestion of President Gilman, he spent a year in Europe purchasing apparatus for his laboratory, becoming acquainted with the prominent scientists of England and the Continent, and making a prolonged

stay in Berlin in order to carry out in Helmholtz's laboratory an investigation which he had long contemplated. He returned to America in 1876, was made professor of physics at Johns Hopkins, and at once began his work. His influence was immediately felt not alone in the University, but throughout the whole country; and students came from both North and South to receive inspiration and guidance. As research after research, discovery after discovery, was made, honors came from both home and abroad; his reputation and renown increased until in the whole country there was no one whose influence in all fields of scientific study or application was so great. It was in Baltimore that nearly all his great work was done, and it was here that he died on the 16th of April.

Professor Rowland was honored by being elected a member of many scientific bodies. He was Honorary Member of the Royal Society of London; Honorary Member of the Royal Society of Edinburgh; Honorary Member of the Royal Academy of Sciences, Berlin; Corresponding Member of the Royal Society of Göttingen; Corresponding Member of the Academy of Sciences of Paris; Honorary Member of the Cambridge Philosophical Society; Honorary Member of the Physical Society of London; Foreign Member of the Royal Swedish Academy of Stockholm; Associate Fellow of the American Academy of Arts and Sciences; Member of the National Academy of Sciences, and a member of nine other learned societies.

He was awarded the Rumford Medal by the American Academy in 1884, the Matteucci Medal in 1897, and received medals at the Exhibitions of Chicago and Paris. He received the honorary degrees of Ph.D. from Johns Hopkins in 1880 and of LL.D. from Yale in 1895 and Princeton in 1896. He was made an officer of the Legion of Honor in 1896.

Even as a young man, Rowland was occupied continually with problems and questions pertaining to chemical and physical science; he had his own laboratory and workshop in which he performed experiments and constructed apparatus. He read the works of Faraday and others and made their subject-matter thoroughly his own. His note-books kept when he was still a youth are full of most remarkable conjectures as to the undiscovered truths of nature, of proposed experiments, of most discriminating and accurate observations, and of many interesting theoretical discussions. It is to be earnestly hoped that the contents of these books will some day be published.

It is hardly necessary to give more than a summary of his most important researches. While at Troy he made those investigations on magnetic induction, permeability and distribution, which at once attracted the attention of Clerk-Maxwell. In Berlin he carried out his experiments on electric convection, which proved that an electrostatic charge carried at a high rate of speed has the same magnetic action as an electric current. (The results of this experiment have recently been called in question; but a repetition of the work during the past winter has confirmed them.) His first important piece of work in Baltimore was the determination of the mechanical equivalent of heat, which necessitated more careful thermometric and calorimetric methods than had ever been used before. He then became interested in questions dealing with electricity and, realizing the importance of accuracy in the measurement of electrical quantities, made a most careful determination of the ohm. This work was repeated and extended later, at the request of the United States Government.

The great problem of the connection between ether and matter was always before him, and in the desire of adding some-

thing to our knowledge he devised many experiments which were carried out by his students under his immediate direction; of these the most important were the one performed by Professor Hall, which led to the discovery of the 'Hall effect,' and those recently performed by Dr. Gilbert, which have led to purely negative results. Becoming interested in the study of spectrum analysis, largely through the influence of his colleague Professor Hastings, he realized the importance of securing as perfect gratings as possible. So he constructed a dividing engine for the ruling of gratings, the essential parts of which were a screw of nearly perfect uniformity of pitch and a most ingenious device for the correction of periodic errors. With this machine many gratings were ruled on both glass and speculum metal, the surfaces being plane. But the idea occurred to him to investigate the action of a grating ruled on a spherical concave surface; he discussed the question mathematically and thus discovered the great advantages of such 'concave gratings,' and proceeded at once to rule them. (It should be noted that all the gratings, both plane and concave, which have been ruled under Professor Rowland's direction and are now in use in all the physical laboratories of the world, have been sold at such prices as simply paid the wages of the laboratory mechanician who supervised their construction.) With these gratings the study of the solar spectrum was begun; and in order to supplement eye-observations, he made a careful study of photographic methods, and prepared his own photographic plates. Having mapped the whole solar spectrum from the extreme red to the limits in the ultra violet, he had enlarged maps prepared and offered to the world. Then he undertook the systematic study of the arc-spectra of all the elements, so far as possible; and the final results of this long research are now nearly ready for publication. Within recent years his attention had been called to the theory of alternating currents and to their application for practical purposes. He devised a system of multiplex telegraphy depending upon synchronous motors, which received a grand medal at the Paris Exposition of 1900.

These are but the most important of Rowland's contributions to science; a complete list would be even more striking. Far more important, however, than the results of the investigations themselves, is the spirit, the aim of the man as made manifest in them. His great purpose was to discover not simply the truth in nature, but the deeply hidden truth. Questions pertaining to the *fundamental* properties of electricity, magnetism, ether and matter were always in his mind; the exact measurement of spectrum lines was interesting to him only in so far as the results might lead to accurate knowledge of molecular constitution or of solar and stellar phenomena; all instruments or methods perfected by him were those which could be used to measure the *great* constants of nature.

To appreciate properly Rowland's greatness as an investigator one must have worked with him. He enjoyed to the utmost the rare gifts of intuitive knowledge and of self-confidence. His energy, his manual dexterity, his ingenuity, his keenness in perceiving and avoiding experimental errors, his skill in devising apparatus, were always evident. No scientist of this generation has had greater power than he of using his imagination under the restraints and guidance of scientific knowledge.

As the director of a great physical laboratory, Rowland was in some ways unique. His enthusiasm and the inspiration of his example were always of the greatest help; his suggestions were invaluable; but his critical powers, his deep insight into any

physical problem, his searching questions were the qualities of untold benefit. He rarely delivered a lecture without calling attention to some subject which needed experimental study; he was never present at a meeting where scientific papers were read or discussed without pointing out some error or possible improvement in the method of experimenting. He was rarely on intimate terms with his students; but no one came near him without recognizing his sweetness of character, his entire freedom from petty faults, his absolute unswerving devotion to the pursuit of truth.

J. S. Ames.

Johns Hopkins University.

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*IMMUNITY AND PROTECTIVE INOCULATION.**

"When we search the history of the development of scientific truth we learn that no new fact or achievement ever stands by itself, no new discovery ever leaps forth in perfect panoply, as Minerva did from the brow of Jove.

"Absolute originality does not exist, and a new discovery is largely the product of what has gone before.

"We may be confident that each forward step is not ordered by one individual alone, but is also the outcome in a large measure of the labors of others. The history of scientific effort tells us that the past is not something to look back upon with regret—something lost, never to be recalled—but rather as an abiding influence helping us to accomplish yet greater successes."—Sir Michael Foster.

"Again and again we may read in the words of some half-forgotten worthy the outlines of an idea which has shone forth in later days as an acknowledged truth."—Sir William MacCormac.

The fact that persons once afflicted with smallpox rarely experienced a second attack of that disease when repeatedly exposed to it was not only early observed, but made a matter of record by the Chinese long before the beginning of the Christian era. That the disease was contagious had long been a matter of common experience, and the means of protection against its ravages early became an interesting subject for investigation.

The Chinese observed that when the dried and pulverized material from smallpox pustules was blown into the nostrils of persons who had not experienced an attack of the disease, the disease in persons thus infected underwent a milder course, was accompanied by a lower death rate, and conferred immunity against further attacks of smallpox. This early method of protection against the ravages of the disease became a common custom in China and India; but was later superseded by a more direct method of inoculation, that of introducing beneath the skin the scab of variolus pustules. The Chinese used the dried scab, the ordinary Hindoos the fluid pus, and the Brahmans pus that had been kept in wool for a period of twelve months. The last is clearly an instance of using attenuated virus.

It should be remembered that smallpox extended westward to Europe during the sixth century, that it reached England toward the close of the ninth century, and at the time of the Crusades became widespread. In 1517 it was carried from Europe to Santo Domingo; reached Mexico in 1520, whence it spread throughout the New World. It was introduced into Iceland in 1707 and to Greenland in 1733.

It should be particularly noted, that in the invasion of new territory the virulence of smallpox at once became greatly intensified—in some instances nearly one-half the population being destroyed by it. Robertson records the death of three million and a half of people in Mexico alone as the result of the invasion of 1520. Again, the dark-colored races seem to be more easily infected than Europeans.

The protective method of directly inoculating the pulverized variolus scab beneath the skin slowly traveled westward; so

*Address of the President of the Texas Academy of Science, given in the Chemical Theater of the University of Texas, on October 26, 1900.